Search for lensed QSOs in the OGLE -IV survey

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• operated since 1992

• OGLE-IV from 2010-now (Udalski et al. 2015)

• OGLE-IV - a billion stars

• 1.3-m Warsaw Telescope at Las Campanas

• http://ogle.astrouw.edu.pl
• 32 CCD chip mosaic camera
• 1.4 sq. deg. total field of view
• scale – 0.26”/pixel
• down to 21 mag in I-band
• 5-6 million stars
Bulge

- half a billion stars
- some fields observed since 1992
- aims: microlensing and variable stars

field cadence:
- red: 10-30 per night
- yellow: 3-10 per night
- green: 1-3 per night
- blue: 0.5-1 per night
- cyan: less than 0.5 per night
- transparent: observed occasionally
Galactic Disk

- 1700 sq deg down to 19 mag
- monitored already for 3 years
- aims: variable stars
Magellanic Clouds

- LMC+MBR+SMC - 670 sq. deg
- some fields observed since 1997
- aims: transients and variable stars

field cadence: 2-6 days
Difference Imaging Analysis

supernova OGLE13-148

DIA accuracy - better than a fraction of a pixel
pixelsize $\sim 0.26''$
Einstein cross (QSO 2237+0305)

Huchra lens: homogeneous data set starting in 1997
The Magellanic Quasars Survey (MQS) has now increased the number of known quasars behind the Magellanic Clouds by almost an order of magnitude using OGLE-III data (Kozłowski et al. 2011, 2013).

OGLE-IV phase: plan to perform a similar, extensive search behind the Magellanic System (Kozłowski in prep.)
QSOs search:
- locating all objects in the WISE survey fulfilling the mid-IR colours criteria for quasars (Stern et al. (2005) and Assef et al. (2010));
- crossmatching the selected WISE objects with the OGLE database;
- performing a variability analysis of the OGLE objects and isolating the final sample.
Search for lensed QSOs

- 670 sq. deg behind the Magellanic System
- prediction: about 10 lensed QSOs (doubles and quads) - Oguri & Marshall 2010

How to find lensed QSOs?

- search for another object around quasar candidates (search radius < 6 arcsec)
- main criteria: similar variability and V-I colour
- exclude the false positive objects with difference image analysis
First candidate

- image A: 19.74 mag
- image B: 19.96 mag

- SED fitting (OGLE I+V, 2mass, WISE): \( z \sim 2.2 \)
- lens: \( z \sim 0.8 \)
- galaxy brightness outside OGLE limits
Lens model & Time delay

- SIS model
- Einstein radius: $\theta_E \sim 0.68$ arcsec

• JAVELIN code - damped random walk model (Zu et al. 2013)
• time delay $\sim 100$ days in observer frame
What next?

- more candidates
- machine learning techniques
- spectroscopic confirmation

phot. by K. Ulaczyk
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References:

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